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STOPPING WATER POLLUTION AT ITS SOURCE

MISA
Municipal/Industrial Strategy for Abatement

ONTARIO'S ORGANIC CHEMICAL MANUFACTURING SECTOR

MONITORING COST ESTIMATES

Environment
Ontario

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Minister

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MUNICIPAL-INDUSTRIAL STRATEGY FOR ABATEMENT (MISA)

ONTARIO'S ORGANIC CHEMICAL MANUFACTURING SECTOR

MONITORING COST ESTIMATES

Socio-Economic Section
Policy and Planning Branch

February 1989

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ABSTRACT

- Estimates of the incremental capital and operating costs to Ontario's nineteen organic chemical manufacturing plants who are direct dischargers subject to MISA monitoring requirements are derived and summarized. Cost estimates include costs provided by plant representatives through the Canadian Chemical Producers' Association (CCPA).

- Five key monitoring activities are identified:
  - sampling requirements
  - analytical requirements (characterization and routine analyses)
  - toxicity testing
  - flow measurement
  - reporting

- Capital costs are estimated to be $2.8 million, +/- $420,000 using a +/- 15% confidence measure.

- Operating costs over the 12 month period are estimated to be $8.1 million.

- Unlike the petroleum refining sector, the organic chemical manufacturing sector monitoring requirements involve plant and pipe-specific requirements. If the OCM sector plants were subject to a single, across-the-board monitoring requirement, as in the petroleum sector, routine monitoring costs could be about $16.2 million. This difference of $10.8 million is a measure of the cost-effectiveness of the pipe-specific nature of the OCM Regulation.

- The cost estimates are not definitive, but indicate different levels of monitoring activity and associated cost ranges.

- An analysis of selected financial impacts on the consolidated financial performance of the organic chemical sector firm, or where possible the chemicals segment of each company, indicates that the effects are varied. Effects on individual plants cannot be easily discerned due to lack of plant-specific financial data.

1.0 BACKGROUND AND PURPOSE OF REPORT

1.1 MISA Objectives

MOE's Municipal-Industrial Strategy for Abatement (MISA) intends to achieve the "virtual elimination of toxic contaminants in municipal and industrial discharges into waterways."

MISA consists of three broad components:

1. Development and promulgation of Regulations which specify (a) contaminant monitoring requirements, and (b) effluent limits.

2. Development of these effluent limits based on "best available technology economically achievable" (BATEA) or water quality impacts.

3. Implementation of abatement programs and enforcement activities.

1.2 Sectors Affected by MISA

The MISA program will encompass at least 200 Ontario industrial establishments which discharge contaminants directly into waterways disaggregated into nine industrial sectors:

- petroleum refining
- organic chemical manufacturing
- pulp and paper
- iron and steel
- metal mining and refining
- industrial minerals and manufacturing
- electric power generation
- inorganic chemical manufacturing
- metal castings.

1.3 Effluent Monitoring Regulation for Ontario's Organic Chemical Manufacturing Sector

The first phase of the MISA regulatory program is the promulgation of monitoring regulations for all plants within each of the industrial sectors listed above.

After the petroleum refining sector, the second sector to come under the monitoring regulation is Organic Chemical Manufacturing (OCM).

Seventeen firms with 19 plant locations in this sector are subject to the monitoring regulations as of August 1, 1988:

1. B.F. Goodrich Canada Inc. (Thorold)
2. BTL Industries Inc. (Belleville)
3. Borg-Warner (Canada) Limited (Cobourg)
4. CanadianOxy Chemicals Ltd. (Fort Erie)
5. Celanese Canada Inc. (Kingston)
6. Cornwall Chemicals Limited (Cornwall)
7. Courtaulds Fibres Canada (Cornwall)
   (formerly Courtaulds North America Inc.)
8. Courtaulds Films (Cornwall)
   (formerly BCL Canada Inc.)
9. Domtar Inc. (Longford Mills)
10. Dow Chemical Canada Inc. (Sarnia)
11. DuPont Canada Inc. (Corunna)
    DuPont Canada Inc. (Kingston)
    DuPont Canada Inc. (Maitland)
12. Esso Chemical Canada (Sarnia)
13. Ethyl Canada Inc. (Corunna)
14. Novacor Chemicals Ltd. (Mooretown)
15. Polysar Limited (Sarnia)
16. Rohm and Haas Canada Inc. (Morrisburg)
17. Uniroyal Chemical Ltd. (Elmira).

The firms and plants within the "sector" were designated for the purposes of the MISA program. Eight of the plants produce products which are classified as organic chemicals (SIC 373). The other plants have SIC classifications ranging from SIC 183 (fabric) to SIC 369 (other petroleum and coal products). While the SIC classifications would not place all of these firms within one category, they have been included together for the purpose of the MISA program because of similarities in the nature of the contaminants in their effluents.

Organic chemical sector monitoring requirements are specified in two regulations:

1. "Effluent Monitoring - General" which specifies common sampling, analysis, toxicity testing, flow measurement, recording and reporting protocols and procedures for all MISA sectors; and

2. "Effluent Monitoring - Organic Chemical Manufacturing Sector" which defines monitoring requirements specific to the OCM sector.

The "Effluent Monitoring - General" regulation came into force June 7, 1988 and will continue in force for each MISA sector.

The Organic Chemical Manufacturing Sector Regulation will come into force five months after it is promulgated and continue in force during the subsequent 12-month period. It will be terminated, except for some daily and weekly monitoring of conventional parameters, at the end of this period. Further monitoring requirements will then be specified in an "Effluent Limits Compliance Regulation" for the sector, expected to be promulgated in 1990-91.

A description of the organic chemical industry in Canada and Ontario is presented in the Economic Profile of the Organic Chemical Manufacturing Sector - Summary Report (Ontario, 1988).

1.4 Purpose and Objectives of Present Report

The monitoring requirements that result from the MISA program will likely be costly to achieve. Cost-effectiveness and benefit-cost implications were among the factors considered in arriving at the agreed-to protocols and requirements. Desired monitoring techniques and technologies have been determined through negotiations with the organic chemical industry through a Joint Technical Committee (JTC).

This report is intended to present estimates of incremental costs to the organic chemical manufacturing sector plants in Ontario of the requirements of the sector monitoring regulation. The report will present an estimate of what the costs will be under the OCM regulations and what the costs could be under certain specific assumptions. To the extent possible, therefore, the cost-effectiveness of the proposed OCM sector monitoring requirements have been examined in the present study.

This report also provides estimates of the impacts of the monitoring costs on certain financial indicators on the OCM sector, and where possible, on individual firms or plants.

This investigation is part of the economic assessment component of the MISA program. The economic rationale, purpose and elements of the economic component of the program are discussed in the report "Economic Information Needs and Assessments for Developing MISA Monitoring and Abatement Requirements" (Ontario, March 1987).

1.5 Cost Estimation Method

In general, two types of incremental costs of monitoring exist, one-time capital expenditures and operating expenses.

Normally, operating costs are recurring annual expenses. However, since the MISA monitoring regulations are in force for only a 12-month period, all operating and capital costs will be assumed to be incurred in a single year. In this report, capital and operating costs have been estimated for each monitoring function at each firm/plant. Capital costs include costs incurred for equipment installations which may have continuing value.

Steps involved in cost estimation include the determination of what activities and items are required to implement each monitoring function, and the stated use of simplifying assumptions where necessary.

Cost estimates are based on specifications in the regulations.

Single-valued or point cost estimates for monitoring activities are presented, but should be treated with some caution because:

- inputs required for different types of monitoring functions are often uncertain;
- there is some flexibility as to how individual plants implement some of the monitoring requirements;
- effluent quality differs from plant-to-plant and from pipe-to-pipe in the OCM sector. This varies the number of parameters to be monitored between plants and pipes.

For the above reasons, ranges of costs are estimated for some monitoring functions where possible.

All cost estimates are expressed in 1988 dollars.

Cost-effectiveness of the monitoring requirements can be examined by comparing the costs associated with the proposed plant and stream-specific requirements to potential costs incurred under a more comprehensive across-the-board set of requirements. Cost implications of varying the frequency and stringency of monitoring requirements for plants and streams show how each individual plant would fare under varying assumptions, and shows how much monitoring costs have been reduced by developing pipe-specific requirements for each plant.

1.6 Pre-Regulation Consultation and Meetings

Industry representatives from the OCM sector spent time at meetings and review committees in order to participate in the development of the regulations.

Industry representatives spent an estimated 271 person-days in meetings with the OCM Sector Joint Technical Committee (JTC) and its Analytical and Regulation Subcommittees. In addition, the OCM sector companies report that about 380 person-days were expended over 12-months to undertake pre-regulation monitoring tasks (D.J. Kerr, 1988). In total, just over 650 person-days were required for pre-regulation assessments, consultation and meetings. This figure is likely an underestimate.

2.0 MONITORING COST ESTIMATES

2.1 Regulation Requirements

The General Effluent Monitoring Regulation specifies requirements for five major monitoring activities which each wastewater discharger must implement to various degrees and levels of effort.

1. Sampling requirements (section 3)
2. Analytical requirements (characterization and routine analyses) (section 4)
3. Toxicity testing (section 5)
4. Flow measurement (section 6)
5. Reporting (section 7)

Eight types of sampling points or effluent streams are defined in the specific Regulation for the OCM sector.

1. Process effluent
2. Combined effluent
3. Batch discharge
4. Once-through cooling water
5. Waste disposal site effluent (leachate)
6. Stormwater
7. Emergency overflow
8. Final discharge

In developing the regulation, the Organic Sector Joint Technical Committee (JTC) considered the cost-effectiveness of the requirements. Initially, it was proposed that all streams of the same type would have the same monitoring requirements, regardless of the manufacturing processes at each site. This is the format currently applied to the Petroleum Refining sector in Ontario because of the similarity in the manufacturing processes employed in that industry.

Pre-regulation monitoring found that the effluents of some plants contained only some of the compounds on MOE's priority pollutants list. Since the potential for contamination by specific pollutant groups varied greatly throughout the sector, plant and stream-specific monitoring requirements were developed. As noted, this is in contrast to the petroleum refining sector, wherein each plant must test for the same compounds at the same frequency.

2.2 Sampling Requirements

Sampling protocols and specifications are defined in Section 3 of the "Effluent Monitoring - General" regulation.

Many plants have indicated that they will likely perform some analyses in-house. This could lower estimated analytical costs, but could also increase estimated capital costs. In fact, it has been the experience of some OCM plants that in-house analyses increase both analytical costs and capital costs. Therefore, as a simplifying assumption, costs in this report are based on contract laboratory pricing.

Calculation of characterization and routine monitoring costs should include the transportation of samples to a commercial laboratory for testing. In this section, therefore, transportation cost estimates are included for discussion purposes.

It can be assumed that each plant will dedicate a vehicle for the collection of samples within the plant. A new van costs about $18,000 to buy or $6,000 per year to lease. Assuming the vehicle travels 10,000 km/year at a government rate of $.275/km., the annual operating cost would be $2,750/plant. If the truck is leased, the annual operating cost would be $8,750 with no capital.

In addition, the vehicle will also have to deliver samples to the commercial laboratory. Taking the round trip distance between each plant and a designated commercial laboratory, the vehicles will travel an additional 3,640 - 33,800 km per year at $.275/km, resulting in an additional annual operating cost of $1,000 - $9,295 per plant.

In total, assuming the truck is leased, annual operating costs for the collection and transportation of samples can range from $9,750 - $18,045. For some plants, these are likely to be overestimates of the capital and operating costs as indicated by the range of cost estimates provided by industry representatives, shown in Table 2.12. The industry estimates are separate from the estimates in this section.

The regulations further require that samples be stored at a temperature no higher than 10°C, and they must be prevented from freezing. Therefore, each plant will require refrigeration equipment to store samples. Some large plants, such as Dow and Polysar, may require more than one refrigerator due to the large number of samples taken and therefore may be able to take advantage of economies-of-scale.

A cost of $2,500 is assumed for each refrigerator to store samples.

Refrigeration equipment is also required to house automatic composite samplers. The cost of these units are usually included in the capital and installation costs of the automatic samplers.

Table 2.1 indicates which plants have currently installed or will require automatic sampling devices and storage or sampler refrigerators.

Automatic flow-proportional samplers, including refrigerators, cost between $7,000 and $10,000. Installation costs, which include temperature recorders, electrical supply, signal cables and construction, are sensitive to site-specific circumstances, and are generally over two times the equipment cost.

In total, based on the foregoing discussion, sampling costs for the OCM sector should be in the order of about $500 thousand. This compares to the total costs for sampling activities, provided by industry representatives, which are estimated to

TABLE 2.1

REFRIGERATORS AND SAMPLING DEVICES REQUIRED

Company/Plant	Refrigerators		Automatic Sampling Device
	Sampler	Storage	
B.F. Goodrich Canada Inc.	NO	YES	NO
BTL Industries Inc.	YES	YES	YES
Borg-Warner (Canada) Limited	NO	YES	NO
CanadianOxy Chemicals Ltd.	YES	YES	NO
Celanese Canada Inc.	YES	YES	NO
Cornwall Chemicals Limited	YES	YES	NO
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	YES	YES	NO
Courtaulds Films (formerly BCL Canada Inc.)	YES	YES	NO
Domtar Inc.	YES	YES	YES
Dow Chemical Canada Inc.	YES	YES	YES
DuPont Canada Inc. - Corunna	YES	YES	YES
DuPont Canada Inc. - Kingston	YES	YES	YES
DuPont Canada Inc. - Maitland	YES	YES	YES
Esso Chemical Canada	YES	YES	YES
Ethyl Canada Inc.	YES	YES	YES
Novacor Chemicals Ltd.	NO	YES	NO
Polysar Limited	YES	YES	YES
Rohm and Haas Canada Inc.	YES	YES	YES
Uniroyal Chemical Ltd.	YES	YES	YES
Total (number of plants requiring devices)	16	19	11

YES = will require a suitable device(s)

NO = has a suitable device(s)

Source: MOE, Water Resources Branch, 1988;
OCM Industry Representatives

range from $0 - $810,000 per year per plant, totaling $2.2 million for the whole sector. The median total sampling cost is $33,000. These point estimates are shown in Tables 2.11 and 2.12.

The broad range of these estimates among the plants reflects the differing sampling requirements among OCM firms. It is possible that the definition of "sampling costs" vary from plant to plant, and may or may not incorporate all the components discussed above.

2.3 Characterization Analyses

Each organic chemical manufacturing sector plant will have to characterize its process and combined effluent and batch discharge streams for 152 of the 186 chemicals listed on the Effluent Monitoring Priority Pollutants List (EMMPL). To the extent that specific parameters are already routinely tested, then additional characterization analyses will not be required. For those parameters which do require characterization analyses, the OCM Sector Regulation (Section 5) specifies two testing frequencies on a stream-specific basis.

Each stream will be characterized twice or four times per year during the 12-month regulation period. The application of stream-specific characterization frequencies ensures that each plant will analyze all possible chemical contaminants related to plant-specific processes. The frequencies are based on the following considerations (OCM Regulation, Section XIV):

- process/site complexity
- process variability
- product/raw material type
- available database
- site geographical location
- past and current environmental performance

As noted earlier, it is assumed that characterization, toxicity testing, and routine analyses will be performed by a commercial laboratory, even through some plants have the ability to conduct many of the obtain comparable cost estimates for each of the plant.

Commercial laboratory test prices are listed in Table 2.2 and are based on a survey of thirty-five such Canadian and U.S. border state laboratories

TABLE 2.2

AVERAGE ONTARIO COMMERCIAL LABORATORY PRICES FOR ANALYTICAL TEST GROUPS

	ANALYTICAL TEST GROUP	AVERAGE PRICE
1	Chemical Oxygen Demand (COD)	$29.78
2	Cyanide	$36.10
3	Hydrogen Ion (pH)	$6.84
4	Nitrogen	$86.99
5	Organic Carbon (DOC)	$57.03
6	Total Phosphorus	$25.12
7	Specific Conductance	$9.44
8	Suspended Solids (TSS/VSS)	$14.87
9	Total Metals	$84.10
10	Hydrides	$23.33
11	Chromium (Hexavalent)	$20.47
12	Mercury	$25.77
13	Total Alkyl Lead	$172.00
14	Phenolics (4AAP)	$42.93
15	Sulphide	$29.80
16	Volatiles, Halogenated	$239.90
17	Volatiles, Non-Halogenated	$176.81
18	Volatiles, Water Soluble	$126.50
19	Extractables, Base Neutral	$427.49
20	Extractables, Acid (Phenolics)	$245.68
21	Extractables, Phenoxy Acid Herbicides *	$188.09
22	Extractables, Organochlorine Pesticides *	$270.14
23	Extractables, Neutral-chlorinated	$232.04
24	Chlorinated Dibenzo-p-dioxins and Dibenzofurans	$1,228.27
25	Solvent Extractables (oil & grease)	$36.00
26	Fatty and Resin Acids	$133.18
27	PCBs (Total)	$103.90
--	Gas Chromatography and Mass Spectrometry Open Scans	$850.00

* Does not apply to the Organic Chemical Sector

Source: M.M.Dillon, "Inventory and Critical Review of Laboratory Resources", July 1988

(Dillon, 1988). The 27 test groups listed contain about 150 individual chemicals. In addition, open and elemental scans must be carried out on each set of samples. The laboratories surveyed include commercial, private, municipal and institutional facilities.

This may therefore cause an under or overestimation in the cost of laboratory testing of samples.

These laboratory test prices are subject to change, and at a later date, this report will be updated to reflect revised, commercial laboratory price schedules.

Prices of laboratory tests include quality assurance/quality control (QA/QC) samples and the preparation of required reports, but does not include transport.

Table 2.3 summarizes characterization analyses costs, excluding transportation, per plant. Total annual characterization costs amount to about $785,000 for the OCM sector. These costs are over and above the routine analytical costs.

These cost estimates do not include pre-regulation characterization analyses, which are estimated by industry to be about $850,000 for the OCM sector (D. Kerr, 1988). Pre-regulation monitoring is not explicitly required by the Regulations.

2.4 Routine Analyses

Routine analyses involve testing of samples taken at four frequency levels - daily, three times per week, weekly and monthly, plus on an event basis for certain sampling points such as emergency overflow.

Table 2.4 indicates that process and combined effluent streams must be tested most frequently. However, each plant has its own specific monitoring requirements under the regulations because of the variety of processes and contaminants ranging from plant to plant. The number of costs of routine monitoring therefore vary from plant to plant.

As seen in Table 2.5, the annual cost of routine analyses range between $43,000 and $1.2 million per plant with a median value of about $180,000. The total point estimate for all 19 plants amounts to $5.4 million per year. These estimates exclude transportation.

TABLE 2.3

OPERATING COSTS
CHARACTERIZATION ANALYSES
($)

Company/Plant	# of Process and Combined Streams	Total
B.F. Goodrich Canada Inc.	1	14,566
BTL Industries Inc.	2	28,078
Borg-Warner (Canada) Limited	1	12,031
CanadianOxy Chemicals Ltd.	1	14,808
Celanese Canada Inc.	4	56,114
Cornwall Chemicals Limited	1	6,029
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	6	85,442
Courtaulds Films (formerly BCL Canada Inc.)	3	41,043
Domtar Inc.	2	28,095
Dow Chemical Canada Inc.	15	113,615
DuPont Canada Inc. - Corunna	2	15,431
DuPont Canada Inc. - Kingston	4	54,480
DuPont Canada Inc. - Maitland	5	56,466
Esso Chemical Canada	2	3,797
Ethyl Canada Inc.	3	36,817
Novacor Chemicals Ltd.	1	8,022
Polysar Limited	11	132,773
Rohm and Haas Canada Inc.	2	27,775
Uniroyal Chemical Ltd.	5	49,396
		784,778

Source: MOE, Water Resources Branch, 1989.

TABLE 2.4

ROUTINE MONITORING REQUIREMENTS

OUTFALL TYPE	FREQUENCY			
	DAILY	3/WEEK	WEEKLY	MONTHLY
Process Effluent	x	x	x	x
Combined Effluent	x	x	x	x
Batch Discharges	x			x
Once-through Cooling Water				x
Final Discharges	x	x	x	x
Stormwater				x
Waste Disposal Site Effluent				x
Emergency Overflows	(as they occur)			

Source: Effluent Monitoring Regulation - Organic Chemical Manufacturing Sector (Sections 6-13), 1989.

TABLE 2.5

OPERATING COSTS - ROUTINE ANALYSES

($000's)

Company/Plant	Test Frequency					% Of
	Daily	Three/Week	Weekly	Monthly	TOTAL	Total
B.F. Goodrich Canada Inc.	32.2	54.9	3.8	2.1	93.0	1.7%
BTL Industries Inc.	53.5	45.6	15.4	10.9	125.4	2.3%
Borg-Warner (Canada) Limited	32.2	43.9	19.9	16.7	112.7	2.1%
CanadianOxy Chemicals Ltd.	26.8	22.6	3.2	8.8	61.4	1.1%
Celanese Canada Inc.	91.6	53.2	22.5	9.0	176.3	3.3%
Cornwall Chemicals Limited	26.8	89.1	3.2	3.3	122.4	2.3%
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	160.5	316.8	42.8	16.0	536.1	10.0%
Courtaulds Films (formerly BCL Canada Inc.)	59.5	125.3	17.2	16.2	218.2	4.1%
Domtar Inc.	38.1	91.6	4.5	10.3	144.5	2.7%
Dow Chemical Canada Inc.	192.7	777.0	86.7	143.4	1,199.8	22.3%
DuPont Canada Inc. - Corunna	32.7	13.5	9.5	7.1	62.8	1.2%
DuPont Canada Inc. - Kingston	65.4	94.1	25.8	29.1	214.4	4.0%
DuPont Canada Inc. - Maitland	56.0	143.7	34.1	40.7	274.5	5.1%
Esso Chemical Canada	32.7	106.1	32.0	11.3	182.1	3.4%
Ethyl Canada Inc.	132.1	266.5	6.9	68.1	473.6	8.8%
Novacor Chemicals Ltd.	26.8	2.3	9.8	4.4	43.3	0.8%
Polysar Limited	216.5	347.0	204.6	183.6	951.7	17.7%
Rohm and Haas Canada Inc.	53.5	4.6	7.2	20.8	86.1	1.6%
Uniroyal Chemical Ltd.	139.2	50.3	48.0	59.5	297.0	5.5%
TOTAL	1,468.8	2,648.1	597.1	661.3	5,375.3	100.0%

Source: MOE, Water Resources Branch, 1989; OCM Sector Monitoring Regulations, 1989

(Totals have been rounded)

2.5 Toxicity Testing

Biological toxicity testing involves the use of the static 96-hour rainbow trout toxicity test and a 48-hour Daphnia magna (a small invertebrate crustacean) mortality (acute lethality toxicity) test.

Process, combined and batch discharge effluents which are final discharge points will be treated monthly while once-through cooling water will be tested quarterly. However, if three consecutive monthly tests result in mortality for no more than two out of ten fish, then the trout test can be reduced to a monthly pass/fail test on 100% undiluted effluent. This provision does not apply to the Daphnia magna test which must be carried out monthly using the acute lethality test protocol.

Table 2.6 presents the number of toxicity tests that could be required annually at each plant for final discharge points including once-through cooling water.

Toxicity testing costs are based on the following prices for full dilution series:

Trout:	$360 per test
Daphnia:	$240 per test
	$600 per test

Pass/fail costs are estimated to be $225 per test.

These prices do not include costs of collecting samples and transport to a laboratory. Based on the experience of some plants, these additional costs can be as much as $100 per test (OCM Industry Representatives, 1988).

Using these prices and the maximum testing schedule from Table 2.6, the total cost of this function during the 12-month period amounts to $326,400 as shown in Table 2.7. If the minimum number of fish toxicity tests were carried out for all plants, the total annual cost for toxicity testing would be $271,320, a difference of $55,080.

2.6 Flow Measurement

Flow measurement is required to allow accurate calculation of total loadings of contaminants discharged to the environment.

TABLE 2.6

NUMBER OF TOXICITY TROUT AND DAPHNIA TEST REQUIRED ANNUALLY FOR EACH PLANT

Company/Plant	Trout	Daphnia
B.F. Goodrich Canada Inc.	12	12
BTL Industries Inc.	24	24
Borg-Warner (Canada) Limited	12	12
CanadianOxy Chemicals Ltd.	12	12
Celanese Canada Inc.	36	36
Cornwall Chemicals Limited	12	12
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	72	72
Courtaulds Films (formerly BCL Canada Inc.)	12	12
Domtar Inc.	12	12
Dow Chemical Canada Inc.	80	80
DuPont Canada Inc. - Corunna	12	12
DuPont Canada Inc. - Kingston	24	24
DuPont Canada Inc. - Maitland	12	12
Esso Chemical Canada	12	12
Ethyl Canada Inc.	12	12
Novacor Chemicals Ltd.	12	12
Polysar Limited	92	92
Rohm and Haas Canada Inc.	12	12
Uniroyal Chemical Ltd.	72	72
	544	544

Source: The Effluent Monitoring Regulation for the Organic Chemical Manufacturing Sector, 1989, MOE, Water Resources Branch, 1989.

TABLE 2.7

ANNUAL OPERATING COSTS TOXICITY TESTING ($)

Company/Plant	Tests		Total
	Trout (Max.)	Daphnia	
B.F. Goodrich Canada Inc.	4,320	2,880	7,200
BTL Industries Inc.	8,640	5,760	14,400
Borg-Warner (Canada) Limited	4,320	2,880	7,200
CanadianOxy Chemicals Ltd.	4,320	2,880	7,200
Celanese Canada Inc.	12,960	8,640	21,600
Cornwall Chemicals Limited	4,320	2,880	7,200
Courtaulds Fibres Canada	25,920	17,280	43,200
Courtaulds Films	4,320	2,880	7,200
Domtar Inc.	4,320	2,880	7,200
Dow Chemical Canada Inc.	28,800	19,200	48,000
DuPont Canada Inc. - Corunna	4,320	2,880	7,200
DuPont Canada Inc. - Kingston	8,640	5,760	14,400
DuPont Canada Inc. - Maitland	4,320	2,880	7,200
Esso Chemical Canada	4,320	2,880	7,200
Ethyl Canada Inc.	4,320	2,880	7,200
Novacor Chemicals Ltd.	4,320	2,880	7,200
Polysar Limited	33,120	22,080	55,200
Rohm and Haas Canada Inc.	4,320	2,880	7,200
Uniroyal Chemical Ltd.	25,920	17,280	43,200
	195,840	130,560	326,400

Source: See Text, Section 2.5

TABLE 2.8

REQUIREMENTS FOR FLOW MEASUREMENT UNDER THE ORGANIC CHEMICAL MANUFACTURING EFFLUENT MONITORING REGULATION

Outfall Type	Flow Measurement Requirements	Accuracy
Process	Continuous	+/- 5% of actual flow for the primary flow measuring device, and +/- 2% of full scale flow for the secondary flow measuring device
Combined	Continuous or daily average if there is no continuous flow measurement in place	+/- 20% of actual flow
Batch Discharge	Measured or estimated flow at the time of sampling	+/- 20% of actual flow
Once-Through Cooling Water	Measured or estimated flow at the time of sampling	+/- 20% of actual flow
Stormwater	Measured or estimated flow at the time of sampling	+/- 20% of actual flow
Waste Disposal Site Effluent	Volume and duration of each discharge event	+/- 20% of actual flow
Emergency Overflow	Event duration and approximate volume of discharge	+/- 20% of actual flow

Source: Effluent Monitoring Regulation - Organic Chemical Manufacturing Sector, 1988;
Effluent Monitoring Regulation - General (Section 6), 1988.

Flow measurement requirements at each type of sampling point are summarized in Table 2.8.

Primary and secondary flow measurement devices are required to achieve the accuracy specified for the process and combined sampling points. Table 2.9 summarizes the status of existing primary and secondary flow measurement devices at each Ontario plant. At least six plants will need to install primary and/or secondary flow measurement devices. The number required at each plant can vary from approximately one to ten.

Installation costs will vary among plants due to site-specific characteristics such as the volume of effluent flow, location of pipes, etc.

Table 2.10 summarizes the estimated outlet pipe sizes and average flow of effluent at each sampling point. These specifications could be used to estimate the costs of flow measurement devices. In a report done for MOE, Gore and Storrie (1987) correlates flow rates and estimated pipe sizes to the costs of different new flow measurement devices. For example, an in-line magnetic flow meter may cost an average of $6,700 for a 6" pipe, and up to $40,600 for a 48" pipe. These costs could be underestimates, since there may be additional installation costs.

Industry representatives were asked to provide estimated capital expenditures for flow measurement. These estimates range from $0 to $325,000 as shown in Table 2.11.

Estimated operating costs of flow measurement provided by industry representatives range from $0 to $50,000 as shown in Table 2.12.

These broad ranges may reflect the fact that some plants already have adequate flow measurement installations.

2.7 Reporting

Monitoring data will have to be assembled, recorded, stored, and reported to company management and to the Ministry of the Environment.

Data storage and manipulation will require an AT personal computer together with compatible peripherals and software, plus personnel dedicated to perform report generation functions.

TABLE 2.9

SUMMARY OF EXISTING FLOW MEASUREMENT DEVICES AT EACH PLANT

Company (Plant)	Outfall Type [1]	Primary Flow Monitoring Device [2]	Secondary Flow Monitoring Device [2]
B.F. Goodrich Canada Inc. (Thorold)	P	•	•
BTL Industries Inc. (Belleville)	C	N/R	N/R
Borg-Warner (Canada) Ltd. (Cobourg)	C	•	•
CanadianOxy Chemicals Ltd. (Fort Erie)	C	•	•
Celanese Canada Inc. (Kingston)	P C1-C2 C3	• • •	• • N/R
Cornwall Chemicals Ltd. (Cornwall)	P	•	•
Courtaulds Fibres Canada (Cornwall) (formerly Courtaulds North America Inc.)	P1-P2 C1-C4	• N/R	• N/R
Courtaulds Films (Cornwall) (formerly BCL Canada Inc.	P1-P2	•	•
Domtar Inc. (Longford Mills)	P C	• •	• N/R
Dow Chemical Canada Inc. (Sarnia)	P1-4,P6,P8,P9 P5,P10 P7 C1-C5	• REQUIRED • N/R	• REQUIRED REQUIRED N/R
DuPont Canada Inc. (Corunna)	C1-C2	N/R	N/R
DuPont Canada Inc. (Kingston)	P1-P2 C1-C2	REQUIRED N/R	REQUIRED N/R
DuPont Canada Inc. (Maitland)	P1-P2 C1-C3	REQUIRED N/R	REQUIRED N/R
Esso Chemicals Canada (Sarnia)	P C	• •	• •
ETHYL Canada Inc. (Corunna)	P1 P2 C	REQUIRED • N/R	REQUIRED • N/R
Novacor Chemicals Ltd. (Moorestown)	C	•	•
Polysar Limited (Sarnia)	P1,P5-P7 P2 P3-P4 C1-C4	REQUIRED • • N/R	REQUIRED REQUIRED • REQUIRED
Rohm and Haas Canada Inc. (Morrisburg)	P C	REQUIRED N/R	REQUIRED N/R
Uniroyal Chemical Ltd. (Elmira)	C1-C5	N/R	N/R

[1] P = Process Effluent
C = Combined Effluent

[2] N/R = No device is required if combined flow may be estimated to +/- 20% accuracy.
• = Plant has a suitable device.

Source: MOE, Water Resources Branch, 1988.

TABLE 2.10

APPROXIMATE FLOW OF EFFLUENTS AND PIPE SIZE REQUIREMENTS AT SAMPLING POINTS

Company (Plant)	Outflow		
	Stream Type [1]	Average Flow ($10^3 m^3/d$) [2]	Pipe Size Required
B.F. Goodrich Canada Inc. (Thorold)	P	1.84	6"
BTL Industries Inc. (Belleville)	C1 C2	3.50 8.18	6" 16"
Borg-Warner (Canada) Ltd. (Cobourg)	C	2.05	6"
CanadianOxy Chemicals Ltd. (Fort Erie)	C	.18	6"
Celanese Canada Inc. (Kingston)	P C1 C2 C3	3.77 37.73 11.37 7.73	6" 16" 16" 16"
Cornwall Chemicals Ltd. (Cornwall)	P	.06	6"
Courtaulds Fibres Canada (Cornwall) (formerly Courtaulds North America Inc.)	P1 P2 C1 C2 C3 C4	1.82 8.18 N/A N/A N/A .03	6" 16" 16" 16" 6" 6"
Courtaulds Films (Cornwall) (formerly BCL Canada Inc.)	P1 P2 C	.55 2.18 N/A	6" 6" 6"
Domtar Inc. (Longford Mills)	P C	.14 1.50	6" 6"
Dow Chemical Canada Inc. (Sarnia)	P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 C1 C2 C3 C4 C5	.68 1.00 .001 .09 N/A N/A 1.00 10.91 1.50 N/A 59.10 30.00 63.64 72.74 350.04	6" 6" 6" 6" 6" 6" 6" 16" 6" 6" 48" 16" 48" 48" 48"
DuPont Canada Inc. (Corunna)	C1 C2	44.55 3.18	48" 6"
DuPont Canada Inc. (Kingston)	P1 P2 C1 C2	.36 .09 33.64 33.64	6" 6" 16" 16"
DuPont Canada Inc. (Maitland)	P1 P2 C1 C2 C3	5.91 N/A 10.91 195.40 218.21	16" 6" 16" 48" 48"
Esso Chemicals Canada (Sarnia)	P C	2.45 29.55	6" 16"
ETHYL Canada Inc. (Corunna)	P1 P2 C	.32 .59 27.28	6" 6" 16"
Novacor Chemicals Ltd. (Moorestown)	C	3.32	6"
Polysar Limited (Sarnia)	P1 P2 P3 P4 P5 P6 P7 C1 C2 C3 C4	N/A 3.00 1.82 1.82 13.00 .06 N/A 20.91 154.56 100.01 N/A	6" 6" 6" 6" 16" 6" 16" 16" 48" 48" 48"
Rohm and Haas Canada Inc. (Morrisburg)	P C	.55 .82	6" 6"
Uniroyal Chemical Ltd. (Elmira)	C1 C2 C3 C4 C5	N/A N/A N/A .18 N/A	6" 6" 48" 6" 6"

[1] P = Process Effluent (NB: P1 = Process Stream 1, etc.)
C = Combined Effluent

[2] N/A = Flow data not available. In these cases, pipe size estimated based on knowledge of the site and the effluent stream.

Source: MOE, Water Resources Branch, 1988.

Cost estimates for reporting as supplied by individual plants vary greatly from $0 up to $100,000, totaling $500,000 for the OCM sector. These differences appear to be due to the availability of existing facilities.

2.8 Intake Water

Another potential sampling point is intake water. The OCM Regulations do NOT specify monitoring requirements for intake water. However, many plants who obtain water from large surfacewater sources which in turn receive the wastewater discharges of other municipalities and industrial plants are currently sampling and testing intake water. Data on intake water quality would permit the firms to determine true net loadings of contaminants generated by the plant. Many OCM sector plants will likely monitor intake water, and cost estimates are presented in this report for comparative purposes.

In general, plants will test intake water only for those chemicals that they must routinely analyze. Table 2.13 shows the intake water monitoring costs per month. Under this assumption, intake water monitoring costs would range from about $3,800 to $38,700 per plant per year (MOE, Water Resources Branch, 1988), and $268,000 for the OCM sector as a whole. These estimates represent extra analytical costs only.

As noted by industry representatives, many firms within the OCM sector are of the opinion that the testing of intake water is an absolute requirement of the Regulations and have provided cost estimates ranging from $19,000 to $160,000 per year. The assumption of monthly monitoring may underestimate the frequency of testing many plants feel they must carry out in order to determine net loadings. OCM sector representatives feel it is more reasonable to assume an average intake water monitoring cost of $40,000 per plant, resulting in a cost of $760,000 for the OCM sector as a whole.

2.9 Total Estimated Costs of the MISA Organic Chemical Manufacturing Sector Monitoring Requirements

Table 2.11 presents a summary of the estimates of capital costs for each monitoring function. The total capital costs of compliance are estimated to be about $2.8 million.

TABLE 2.11
SUMMARY OF CAPITAL COSTS (*)
($000's)

	Monitoring Function							
Company/Plant	Sampling	Characterization Analyses	Routine Analyses	Toxicity Testing	Flow Measurement	Reporting	TOTAL CAPITAL COSTS	% OF TOTAL
B.F. Goodrich Canada Inc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
BTL Industries Inc.	20.0	0.0	0.0	0.0	6.0	0.0	26.0	0.9%
Borg-Warner (Canada) Limited	20.0	0.0	35.0	0.0	15.0	0.0	70.0	2.5%
CanadianOxy Chemicals Ltd.	18.0	0.0	0.0	0.0	4.0	0.0	22.0	0.8%
Celanese Canada Inc.	33.0	0.0	0.0	0.0	33.0	0.0	66.0	2.3%
Cornwall Chemicals Limited	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Courtaulds Fibres Canada	50.0	0.0	0.0	0.0	50.0	0.0	100.0	3.6%
(formerly Courtaulds North America Inc.)								
Courtaulds Films	20.0	0.0	0.0	0.0	20.0	0.0	40.0	1.4%
(formerly BCL Canada Inc.)								
Domtar Inc.	20.0	0.0	0.0	0.0	32.0	10.0	62.0	2.2%
Dow Chemical Canada Inc.	430.0	0.0	0.0	0.0	110.0	50.0	590.0	21.0%
DuPont Canada Inc. - Corunna	41.0	0.0	0.0	0.0	75.0	1.0	117.0	4.2%
DuPont Canada Inc. - Kingston	60.0	0.0	35.0	0.0	20.0	0.0	115.0	4.1%
DuPont Canada Inc. - Maitland	16.0	0.0	0.0	0.0	20.0	0.0	36.0	1.3%
Esso Chemical Canada	100.0	0.0	0.0	0.0	75.0	75.0	250.0	8.9%
Ethyl Canada Inc.	46.0	0.0	167.0	0.0	51.0	11.0	275.0	9.8%
Novacor Chemicals Ltd.	12.0	0.0	20.0	0.0	0.0	0.0	32.0	1.1%
Polysar Limited	475.0	0.0	0.0	0.0	475.0	0.0	950.0	33.8%
Rohm and Haas Canada Inc.	30.0	0.0	0.0	0.0	30.0	1.0	61.0	2.2%
Uniroyal Chemical Ltd.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
TOTAL	1,391.0	0.0	257.0	0.0	1,016.0	148.0	2,812.0	100.0%

* Source: OCM Industry Representatives

Capital cost estimates are subject to varying degrees of uncertainty. Representatives of firms who provided these estimates indicate that this uncertainty could range from +/- 5% to +/- 25%. Using an average uncertainty measure of +/- 15%, the total capital costs of the regulation requirements could range from $2.4 million to $3.2 million.

Table 2.12 presents a summary of the estimates of operating costs for each monitoring function. The total operating costs of compliance are estimated to be about $8.1 million, and will be incurred over the 12-month period of the monitoring Regulation.

The estimated total incremental costs based on the monitoring functions in the OCM effluent-specific schedules for the nineteen plants are as follows:

Sampling	$2.5 million
Characterization	$0.8 million
Routine Monitoring	$5.7 million
Toxicity Testing	$0.3 million
Flow Measurement	$1.1 million
Reporting	$0.5 million.

Total operating and capital costs to the OCM sector of complying with MISA monitoring requirements are summarized in Table 2.13. Also included in this table, as discussed in Section 2.8, are estimated intake water monitoring costs.

The total estimated cost of monitoring for the OCM sector of the MISA related requirements is $10.9 million. This does not include estimated intake water monitoring costs.

2.10 Alternative Estimates of Routine Monitoring Costs

As noted in Section 1.4, this report presents estimates of routine monitoring costs under the Organic Chemical Manufacturing Sector Regulation. In order to place these estimated costs in an analytical context, estimates of routine monitoring costs under an alternative set of assumptions have been developed.

The Organic Chemical Sector Regulation involves plant and stream-specific considerations. If, however, the Regulation was applied in a manner similar to the petroleum refining sector, Ontario's OCM plants would be required to adhere to a single across-the-board monitoring requirement.

TABLE 2.12
SUMMARY OF OPERATING COSTS
($000's)

ompany/Plant	Monitoring Function Sampling (*)	Charact-erization Analyses	Routine Analyses	Toxicity Testing	Flow Measure-ment (*)	Reporting (*)	TOTAL OPERATING COSTS	% OF TOTAL
.F. Goodrich Canada Inc.	21.0	14.6	93.0	7.2	0.0	3.0	138.8	1.7%
TL Industries Inc.	0.0	28.1	125.4	14.4	0.0	0.0	167.9	2.1%
org-Warner (Canada) Limited	35.0	12.0	112.7	7.2	0.0	15.0	181.9	2.3%
anadianOxy Chemicals Ltd.	2.0	14.8	61.4	7.2	0.0	1.0	86.4	1.1%
elanese Canada Inc.	0.0	56.1	176.3	21.6	0.0	0.0	254.0	3.2%
ornwall Chemicals Limited	0.0	6.0	122.4	7.2	0.0	0.0	135.6	1.7%
ourtaulds Fibres Canada formerly Courtaulds North America Inc.)	22.0	85.4	536.1	43.2	0.0	15.0	701.7	8.7%
ourtaulds Films formerly BCL Canada Inc.)	0.0	41.0	218.2	7.2	0.0	0.0	266.4	3.3%
omtar Inc.	0.0	28.1	144.5	7.2	0.0	25.0	204.8	2.5%
ow Chemical Canada Inc.	380.0	113.6	1,199.8	48.0	50.0	98.8	1,890.2	23.5%
uPont Canada Inc. - Corunna	33.0	15.4	62.8	7.2	2.0	5.0	125.4	1.6%
uPont Canada Inc. - Kingston	35.0	54.5	214.4	14.4	0.0	10.0	328.3	4.1%
uPont Canada Inc. - Maitland	75.0	56.5	274.5	7.2	0.0	25.0	438.2	5.4%
sso Chemical Canada	51.0	3.8	182.1	7.2	30.0	100.0	374.1	4.6%
thyl Canada Inc.	25.2	36.8	473.6	7.2	25.1	8.0	575.9	7.2%
ovacor Chemicals Ltd.	2.0	8.0	43.3	7.2	0.0	5.0	65.5	0.8%
olysar Limited	366.0	132.8	951.7	55.2	0.0	60.0	1,565.7	19.5%
ohm and Haas Canada Inc.	30.5	27.8	86.1	7.2	0.0	4.5	156.1	1.9%
niroyal Chemical Ltd.	0.0	49.4	297.0	43.2	0.0	0.0	389.6	4.8%
TOTAL	1,077.7	784.7	5,375.3	326.4	107.1	375.3	8,046.5	100.0%

Source: OCM Industry Representatives

ource: MOE, Water Resources Branch, 1989; OCM Sector Monitoring Regulations, 1989

TABLE 2.13
TOTAL ESTIMATED COST OF MONITORING
($000's)

COMPANY/PLANT	TOTAL CAPITAL COSTS (1)	TOTAL OPERATING COSTS (2)	TOTAL COSTS	% OF TOTAL	INTAKE WATER (3)	TOTAL
B. F. Goodrich Canada Inc.	0.0	138.8	138.8	1.3%	8.3	147.1
BTL Industries Inc.	26.0	167.9	193.9	1.8%	11.3	205.2
Borg-Warner (Canada) Inc.	70.0	181.9	251.9	2.3%	9.3	261.2
CanadianOxy Chemicals Ltd.	22.0	86.4	108.4	1.0%	7.6	116.0
Celanese Canada Inc.	66.0	254.0	320.0	2.9%	4.9	324.9
Cornwall Chemicals Limited	0.0	135.6	135.6	1.2%	11.8	147.4
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	100.0	701.7	801.7	7.4%	13.2	815.0
Courtaulds Films (formerly BCL Canada Inc.)	40.0	266.4	306.4	2.8%	13.2	319.6
Domtar Inc.	62.0	204.8	266.8	2.5%	9.8	276.6
Dow Chemical Canada Inc.	590.0	1,890.2	2,480.2	22.8%	38.7	2,519.1
DuPont Canada Inc. - Corunna	117.0	125.4	242.4	2.2%	5.7	248.1
DuPont Canada Inc. - Kingston	115.0	328.3	443.3	4.1%	11.8	455.1
DuPont Canada Inc. - Maitland	36.0	438.2	474.2	4.4%	23.6	497.8
Esso Chemical Canada	250.0	374.1	624.1	5.7%	14.0	638.2
Ethyl Canada Inc.	275.0	575.9	850.9	7.8%	17.4	868.4
Novacor Chemicals Ltd.	32.0	65.5	97.5	0.9%	3.8	101.3
Polysar Limited	950.0	1,565.7	2,515.7	23.2%	24.3	2,540.2
Rohm and Haas Canada Inc.	61.0	156.1	217.1	2.0%	11.7	228.8
Uniroyal Chemical Ltd.	0.0	389.6	389.6	3.6%	28.0	417.6
TOTAL	2,812.0	8,046.5	10,858.5	100.0%	268.4	11,127.9

(1) From Table 2.11

(2) From Table 2.12

(3) Intake water monitoring is NOT specified as part of the OCM regulations, but is carried out by many plants. These costs assume a frequency of monthly testing. See Section 2.8 for discussion.

Using this scenario, an alternative set of routine monitoring costs were estimated with the following assumptions in place:

1. The organic chemical manufacturing sector plants subject to the MISA regulations would have to routinely monitor all of their process and combined effluent streams for a maximum number of contaminants.

2. All of these plants would have to meet the most stringent requirements applied under the currently proposed regulations.

As shown in Table 2.14, this "stringent" scenario resulted in routine monitoring costs ranging from $228,300 to $3.4 million per plant, and $16.2 million for the entire OCM sector, as compared to the total estimated routine monitoring costs, shown in Table 2.5, of $5.4 million. The median cost under the "stringent" scenario was $457,000 compared to $180,000 under the proposed regulations.

Although the implications of this scenario for other monitoring functions were not calculated, it is possible that costs associated with characterization analyses, for example, may be reduced for some plants.

In summary, if each plant in the OCM sector was subject to a common set of analytical requirements, as in the petroleum refining sector, total routine monitoring costs would total approximately $16.2 million. This is $10.8 million more than the point estimate of the routine analyses costs required by the Regulation.

This difference of $10.8 million is a measure of the cost-effectiveness of the pipe-specific approach proposed for the organic chemical manufacturing sector. MOE has been cognizant of the potential financial implications of the MISA requirements, and has incorporated such considerations in the development of policy initiatives without a significant loss of technical data.

TABLE 2.14
ALTERNATIVE ROUTINE MONITORING COST ESTIMATE
($000's)

Company/Plant	OCM Sector Regulation (1)	Alternative Scenario (2)	Difference	
			$	%
B. F. Goodrich Canada Inc.	93.0	228.3	135.3	145.5%
BTL Industries Inc.	125.4	456.7	331.3	264.2%
Borg-Warner (Canada) Limited	112.7	228.3	115.6	102.6%
CanadianOxy Chemicals Ltd.	61.4	228.3	166.9	271.8%
Celanese Canada Inc.	176.3	913.4	737.1	418.1%
Cornwall Chemicals Limited	122.4	228.3	105.9	86.5%
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	536.1	1,370.0	833.9	155.5%
Courtaulds Films (formerly BCL Canada Inc.)	218.2	685.0	466.8	213.9%
Domtar Inc.	144.5	456.7	312.2	216.1%
Dow Chemical Canada Inc.	1,199.8	3,425.1	2,225.3	185.5%
DuPont Canada Inc. - Corunna	62.8	456.7	393.9	627.2%
DuPont Canada Inc. - Kingston	214.4	913.4	699.0	326.0%
DuPont Canada Inc. - Maitland	274.5	1,141.7	867.2	315.9%
Esso Chemical Canada	182.1	456.7	274.6	150.8%
Ethyl Canada Inc.	473.6	685.0	211.4	44.6%
Novacor Chemicals Ltd.	43.3	228.3	185.0	427.3%
Polysar Limited	951.7	2,511.7	1,560.0	163.9%
Rohm and Haas Canada Inc.	86.1	456.7	370.6	430.4%
Uniroyal Chemical Ltd.	297.0	1,141.7	844.7	284.4%
TOTAL	5,375.3	16,212.0	10,836.7	201.6%

Source: Table 2.5; OCM Sector Monitoring Regulations, 1989

(1) Pipe-specific requirements for monitoring.
(2) All plants monitor for a common list of contaminants.

3.0 ECONOMIC EFFECTS AND IMPLICATIONS OF MONITORING COSTS

3.1 Method

The monitoring costs incurred by the firms under the MISA regulations will increase operating expenses and, unless there is some offsetting increase in productivity associated with wastestream monitoring, profits to the firms and returns on the particular operation may be reduced.

In this section, some of the key effects of these costs on the OCM sector as a whole, and on individual firms within the sector, will be examined.

The sectoral analysis will examine how these extra costs may impact on international and provincial competitiveness, employment and profitability.

For each firm or plant in the sector for which data are available, the extent to which the incremental monitoring costs may affect the production costs, profits and certain other financial measures will be determined. Effects on performance measures will be assessed in relation to the average financial performance for each firm over five years, as well as the worst year in the same timeframe for which relevant data are available. A key question is to determine the extent to which the monitoring costs would reduce the company's performance measures below its own historical averages. Comparisons will also be made with industry performance measures where these are available.

Monitoring costs are assumed to impact the company in the following ways:

- operating costs of monitoring will increase the firm's annual operating expenses and are fully deductible from after-tax earnings;

- capital costs would normally be depreciated over 3 to 5 years. Only a proportion of the capital costs should, therefore, be deducted from profits or earnings each year. However, to be conservative, it will be assumed that capital costs are fully deducted in the 12-month period.

Full deduction of the extra operating and capital costs from after-tax earnings or profits overestimates the impact because depreciation and an offsetting reduction in income taxes (resulting in an increase in after-tax profits) is ignored.

Financial data are seldom available at the plant level although it is at this level that financial consequences will usually influence decisions or affect the viability of an operation. Assessments and comparisons will generally have to be made against consolidated company data which are publicly available.

For some firms, notably the major petrochemical companies, a limited amount of disaggregated data on the chemicals segments of their businesses are published. These data will be used to supplement the analyses based on consolidated company data where possible. Two or three companies in the OCM sector operate only one plant so that company data represent the plant as well.

3.2 Sector Economic Impact

As discussed in the Summary Economic Profile (MOE, 1988), the organic chemical firms in the OCM Sector can be characterized by some basic features.

- firms are price takers, with benchmark prices set internationally, primarily by American producers;
- petrochemical plants are capital intensive so that entry and exit can be very expensive; and
- the organic chemical manufacturing plants are net exporters of bulk petrochemicals while Canada is a net importer of organic and specialty chemicals.

Petrochemical producers in the OCM Sector sell to competitive markets. These firms therefore cannot easily pass on additional costs in higher prices unless all other firms, especially the producers on the U.S. Gulf Coast, are subject to the same costs. Only seventeen (17) firms will bera these monitoring costs initially out of fifty-four (54) that operate in Ontario. Although the rest of these companies and their plants will eventually be subject to MISA requirements through sewer use regulations, the nineteen (19) direct discharging plants will have to incur monitoring costs before any of the others.

The total point estimate of the monitoring costs, as shown in Table 2.13, is about $10.9 million for the OCM Sector. These costs can be put in context by comparing them to OCM sector statistics for 1982-1986. These data are derived from CCPA figures, and can be seen in Table 2 of the Summary Economic Profile (MOE, 1988).

The average annual capital expenditure of the OCM Sector from 1982 to 1986 was $599 million. The $2.8 million in capital costs of monitoring represent a 0.5% increase in the sector's average annual capital expenditures. The lowest capital expenditure occurred in 1985, when $256 million was invested. Monitoring capital costs amount to 1.1% of this figure.

For the sector as a whole therefore, the capital costs of the monitoring requirements would add between 0.5% and 1.1% to capital expenditure levels.

In terms of employment, the economic impacts will likely be neutral to slightly positive. The requirements of the Regulation might stimulate job opportunities for personnel to collect and analyze samples. Further employment opportunities will likely be generated in the form of consultants, analytical laboratories, and equipment manufacturers. Employment reductions would only take place if a company closes down all or part of a plant.

The total estimated costs of monitoring would reduce average (1982-1986) pre-tax profits of the OCM firms about 7.1%. In their worst year, 1985, firms in the OCM sector experienced a total pre-tax loss of $47 million. The total MISA monitoring costs would have increased this loss by 23.2%. If only the operating costs of monitoring were considered, the average pre-tax profits would have been reduced by 5.3%, and losses in the worst year would have increased by 17.4%.

Aggregate data on after-tax profit levels for the petrochemical sector indicate that this part of the OCM sector has been in a loss position over the five (5) year period of 1982-1986. Total monitoring costs would have increased average losses by 5.0%. Operating costs of monitoring alone would have increased average losses by 3.8%. The worst year for the sector, again during 1985, showed a net loss of $520 million. The monitoring costs would have increased the net loss in that year by 2.1%, and operating costs alone by 1.6%. A review of individual petrochemical company statistics indicate positive after-tax earnings in recent years.

The monitoring costs are not expected to adversely affect the international competitiveness of the firms in the OCM sector because the monitoring makes up a small fraction of the aggregate industry costs and profits and because the bulk of the monitoring of costs will be incurred for only one year.

Demand, sales and earnings for the organic chemical industry in the medium term are bouyant. Firms are planning to increase capacity to take advantage of relatively lower feedstock prices and rising demand for chemical products. Monitoring costs will, therefore, have a much smaller impact over the next 12-24 months than they would if they have been incurred in previous years.

3.3 Financial Analyses of OCM Sector Firms

Because plant-specific data are not generally available, the financial effects of monitoring costs in each plant must, therefore, be assessed against consolidated company data which are publicly available. Assessments of the implications of the MISA monitoring costs can be made in relation to the following financial performance measures:

- capital expenditures;
- net income (after-tax earnings);
- total operating expenditures;
- return on capital invested;
- working capital; and
- rate of return on total assets employed.

Where possible, the implication of the monitoring costs are assessed in related to each firm's five (5) year average (1983-1987) performance, and in relation to the worst year within the same timeframe. Exceptions will be noted.

It is assumed that all of the firms in this sector operate in a competitive market and will not be able to pass on cost increases in higher prices.

This assumption may be overly conservative for some firms which produce specialty chemicals and which have enjoyed tariff protection. Costs incurred over the 12-month monitoring period will be reflected in reduced after-tax profits.

Table 3.1 shows how each plant's monitoring costs compare with capital expenditure and net profit trends for each company. Monitoring cost estimates are summarized in Table 2.13.

Estimated capital costs of monitoring represent less than 1% of company capital expenditures. Rohm and Haas is an exception, with capital costs of monitoring representing 3.3% of average capital expenditures.

The impact on average after-tax earnings is also relatively low, with representative percentages of operating costs of monitoring ranging from 0.1% to 3.4%. Two exceptions must be noted. Dow experienced large after-tax losses in 1984 and 1985, but had a sizeable after-tax profit in 1987. The financial analyses in Table 3.1 are therefore not truly representative of the potential impact of the monitoring costs. If the 1987 net income level of $138 million were used, the representative percentage would be 1.4%.

Similarly, Polysar experienced relatively low after-tax earnings between 1983 and 1986. In 1987, net income rose to $168 million as compared to the $19 million posted in 1986. Using the 1987 net income level, the representative percentage would be 0.9%.

Although small in comparison to the consolidated earnings of the parent firms, these extra costs may have a significant effect on a segment of the parent firm's business or on the plant to which these costs apply. Accordingly, using corporate annual statistics for Ethyl and Imperial Oil, the impacts of the monitoring costs on capital expenditures and net income were determined for their respective chemicals divisions. The results are shown in Table 3.1. Note that for Ethyl, the average after-tax earning figure of $163 million is really pre-tax, expense and interest, thereby making it appear higher than the consolidated corporate net income level.

The monitoring costs will also impact on other performance measures represented by ratios. The rate of return on capital invested is a measure of

TABLE 3.1

FINANCIAL IMPACT OF MONITORING COSTS

Company/Plant	Capital Expenditures			After-Tax Earnings		
	Average 1983-1987 ($ Millions)	% Represented by Point Estimate Capital Cost of Monitoring		Average 1983-1987 ($ Millions)	% Represented by Point Estimate Operating Cost of Monitoring	
		Average	Lowest		Average	Lowest
B.F. Goodrich Canada Inc.	19.7	0	0	19.7	0.7	0.8
BTL Industries Inc.	N/A			N/A		
Borg-Warner (Canada) Limited	N/A			N/A		
CanadianOxy Chemicals Ltd.	130.0	0.02	0.1	68.1	0.1	0.3
Celanese Canada Inc.	22.7	0.3	0.5	8.2	3.1	(4.6)
Cornwall Chemicals Limited	*			*		
Courtaulds Fibres Canada (formerly Courtaulds North America Inc.)	*			*		
Courtaulds Films (formerly BCL Canada Inc.)	*			*		
Domtar Inc.	298.6	0.02	0.1	110.1	0.2	0.5
Dow Chemical Canada Inc.	81.0	0.7	1.0	0.4	**	(1.1)
DuPont Canada Inc. - Corunna)	60.0	0.5	1.1	42.7	2.1	(3.4)
DuPont Canada Inc. - Kingston)						
DuPont Canada Inc. - Maitland)						
Esso Chemical Canada (Imperial Oil)	928.0	0.03	0.04	497.6	0.1	0.1
Chemicals Division	41.4	0.6	1.1	13.2	2.8	(3.7)
Ethyl Canada Inc. (Parent Company)	110.0	0.3	0.3	145.2	0.4	0.5
Chemicals Division	65.8	0.4	0.6	162.9	0.4	0.6
Novacor Chemicals Ltd.	263.1	0.01	0.02	87.1	0.1	(0.1)
Polysar Limited	96.0	1.0	1.7	46.2	3.4	**
Rohm and Haas Canada Inc.	1.9	3.3	4.7	9.4	1.7	1.8
Uniroyal Chemical Ltd.	7.4	0	0	23.3	1.9	3.0

N/A - No data available. * - Insufficient data available. ** - Greater than 100%.
Source: Company Annual Reports

how well equity (capital) has been invested and utilized to enhance net income. A lower ratio indicates relatively poor management performance. The rate of return on total assets employed is measure of profitability and the best utilization of assets available to the firm.

All the firms with available data have sufficiently large working capital amounts to cover the monitoring costs. Firms which do not have sufficient working capital may need to seek external financing. In these cases, financial measures such as the debt/equity ratio will require examination.

These financial impacts are, on the whole, related to consolidated financial statistics. A review of company annual reports indicates that their chemicals divisions are profitable and expanding capacity.

For example, Imperial Oil, the parent company of Esso Chemical has a chemicals division consisting of petrochemicals and agricultural chemicals. this division currently accounts for just over 11% of total revenues, and has grown from a loss of $10 million in 1983 to a $34 million profit in 1987. The return on average capital employed grew from (0.9%) in 1983 to 3.7% in 1987. Demand for petrochemical products is currently growing, with sales volumes and profit margins increasing (Imperial Oil Annual Report, 1987).

Ethyl Corporation, the U.S. parent company of Ethyl Canada, is involved in several markets, including chemicals, energy, and insurance. Its chemicals division accounts for almost 50% of total sales revenues, which were $1.2 billion in 1987, and increase of 12% over 1986. Chemicals were responsible for a $237 million operating profit in 1987, which was 60% of total profit. Ethyl Corporation also expended about $7 million in 1987 for pollution abatement. The Chemicals Group expanded capacity at "unprecedented" levels in 1987, with new plants scheduled for completion in 1988 (Ethyl Corporation Annual Report, 1987).

The B.F. Goodrich plant in Ontario subject to the MISA monitoring requirements produces PVC (polyvinyl chloride) plastics. Its parent company, B.F. Goodrich, has a separate PVC and Intermediates Division which had sales revenues of $866 million in 1985 growing to $1.1 billion in 1987. By 1987, this division accounted for 49% of total sales revenues. Operating income for this division grew from a loss of $185 million in 1985 to a $144 million profit in 1987. Total U.S. domestic demand for PVC grew 7.3% in 1987, compared to 6.4% in 1986. Because of high demand for PVC as a substitute for plastic and other non-plastic materials, many producers, including B.F. Goodrich were unable to maintain adequate supply (B.F. Goodrich Annual Report, 1987).

Other MISA firms involved in PVC production or inputs to PVC production include Dow, DuPont, Esso, and Novacor. It is expected that the PVC market will continue to expand.

Courtaulds Fibres (formerly Courtaulds North America), and Courtaulds Films (formerly BCL Canada Inc.) are both owned by Courtaulds PLC, a multinational textile company headquartered in Britain. Courtaulds Films has incurred losses over the past three years. This plant manufactures cellophane, for which world demand is declining due primarily to the availability of product substitutes. Courtaulds Fibres also has a history of losses, but has become profitable in the last two fiscal years. This plant produces viscose and rayon from wood pulp and therefore sells to a different market than the other OCM sector firms. Data for Courtaulds Fibres are available only up to 1985. Therefore, any financial analyses against these financial indicators would be misleading.

The preceding analysis indicates that the imposition of monitoring costs will not pose an undue financial or economic burden on those firms within the OCM Sector for which financial data were available. The lack of plant-specific data limits a comprehensive assessment of how the monitoring costs affect the competitiveness of individual plants in the OCM sector.

Benefits

It should also be stressed that the monitoring not only involves costs to the affected firms. Monitoring has resulting in benefits and cost savings in firms. For example, an Exxon refinery in the U.S. estimated that it saved about $3,000 a day by detecting process leaks the same day they occurred because of the presence of specific pollution monitoring instrumentation (Cracking Down, 1975, p. 98).

Public benefits from the MISA pollution monitoring requirements include information that will help design cost-effective abatement programs and which can be used in research to detect and prevent human health and environmental risks. These benefits, which are the raison d'etre of the MISA monitoring regulations, are, nevertheless, more difficult to quantify and value.

Other benefits of the monitoring requirements include enhanced employment opportunities and the possible development of innovative technologies with their own export potential.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Based on a comparison of the estimated monitoring costs of the proposed regulation with potential costs of an across-the-board common set of requirements, the plant and pipe specific monitoring requirements are cost-effective. About $10.8 million is the measure of the cost-effectiveness of tailoring monitoring requirements to each plant.

The economic impacts of the estimated monitoring costs on the OCM sector are small in relation to aggregate sectoral financial indicators. Since additional costs cannot easily be passed on as higher prices, average sector pre-tax profit levels (1982-1986) would have been reduced by 7.1%. In the Petrochemical sector, average after-tax losses would have been increased by just over 5%. The sector is not in a position to influence international markets, but is experiencing growth and optimism for continued profitability.

For the individual OCM sector firms subject to MISA monitoring requirements, impacts are varied, but do not seem to be unduly burdensome. Impacts on average after-tax profits range from 0.1% to 3.4%. However impacts on individual plants cannot be easily discerned due to lack of plant-specific financial data.

The monitoring requirements will also produce benefits in the form of enhanced employment opportunities, technology development, and a sufficient database which can be used to design cost-effective control programs aimed at eliminating toxic contamination of waterways.

4.2 Recommendations

The foregoing analyses indicate that the financial impacts of the monitoring regulations on plants within the organic chemical manufacturing sector can be varied. In order to identify possible problems at an early stage, it is recommended that the MOE also monitor the actual incremental capital and operating costs of the monitoring activities during the tenure of the Regulations. Early identification of possible financial burdens will enable MOE and the individual plant to review and assess workable solutions.

Also, at the end of the regulation period, each plant should attempt to record and report the actual incremental costs incurred due to the MISA monitoring requirements in order to:

- validate and improve the cost-estimation procedures used in this report.
- monitor and assess the financial and employment impacts of the monitoring requirements, especially on individual plants.
- help to determine the full financial impact of the MISA requirements when the costs of the limits regulations are determined.

Finally, when monitoring data and activities at these plants (and other industrial dischargers) are audited by MOE personnel or their agents, information should be gathered to determine whether the monitoring activities or data have been, or could be, helpful in making the operations or processes more efficient and productive.

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